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ABSTRACT

The pamphlet "Skylab" describes very generally the kinds of activities to be conducted with the Skylab, America's first manned space station. "Space Shuttle" is a pamphlet which briefly states the benefits of the Space Shuttle, and a concise review of present and future benefits of space activities is presented in the pamphlet "Space Benefits Today and Tomorrow." (PR)

Skylab

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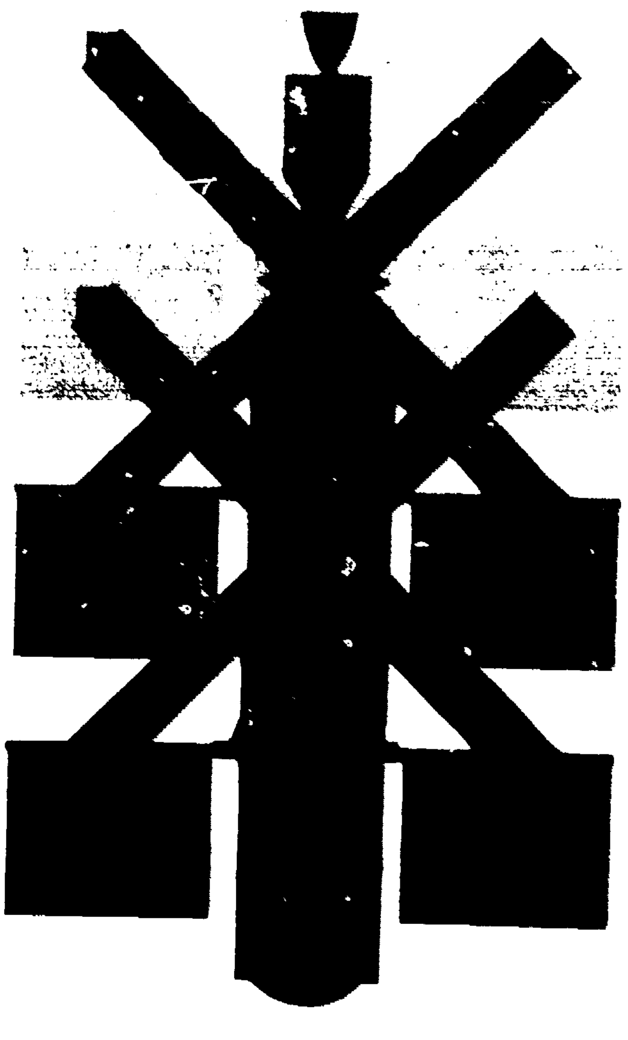


Skylab will be the first United States manned space flight program developed specifically to carry activities and equipment aimed at improving man's life on Earth.

Skylab will evaluate systems and techniques designed to gather information on Earth's resources and environmental programs.

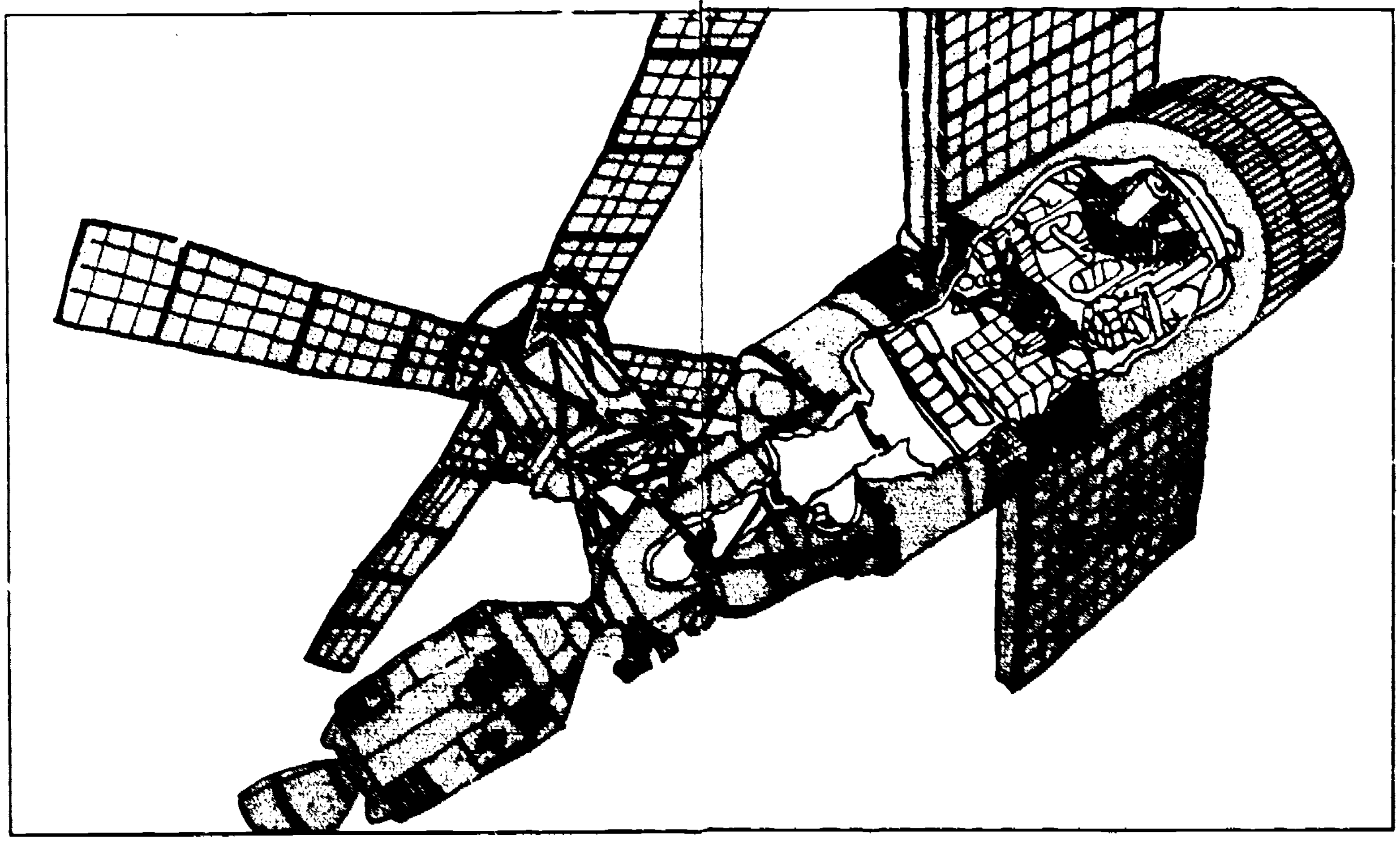
Skylab's solar telescopes will substantially increase man's knowledge of our Sun and the multitude of solar influences on Earth's environment.

Medical experiments performed aboard Skylab will increase knowledge of man himself and his relationship to his Earthly environment and adaptability to space flight.

Additionally, Skylab will experiment with industrial processes which may be enhanced by the unique weightless, vacuum environment of space.

The Skylab workshop is America's first manned space station. In its 390 cubic-meter (13,000 cubic-foot) interior, three-man crews will conduct nearly sixty experiments during space missions which will last as long as 56 days. NASA has invited world wide participation in analyses and interpretation of the resulting data.

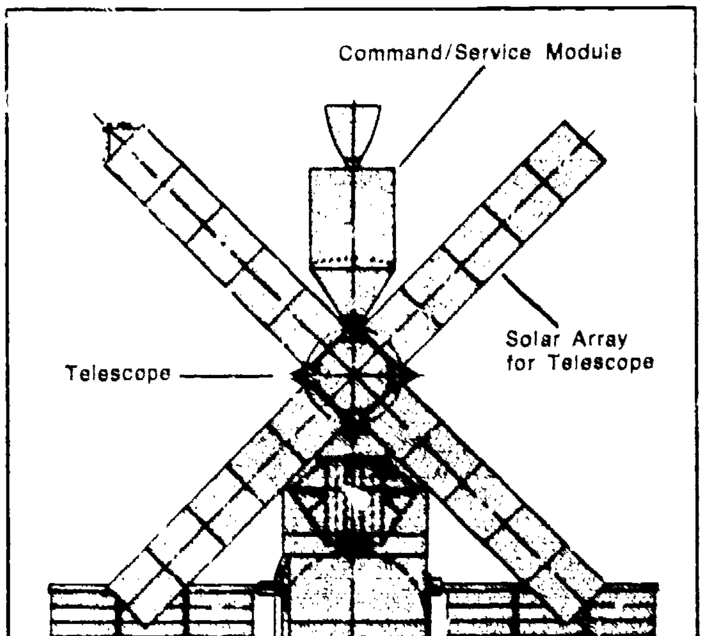
Remote sensing of Earth from space is a potentially effective technique for conservation of natural resources on a global scale, and for better understanding and management of the interaction between man and these natural resources. Systematic application of remote sensing techniques over large areas of the Earth will be undertaken from Skylab. Remote sensing will be used for mapping geographic and weather features, crop and forestry cover, health of vegetation, types of soil, water storage in snow pack, geologic features associated with surface or near-surface



mineral deposits, sea surface temperature, wind and sea conditions, and the location of likely feeding areas for fish.

Skylab will fly over the entire United States except Alaska, and its flight path will cover about 75 percent of the Earth's surface. Skylab will repeat its track every five days during the 8-month lifetime of the Skylab Program.

The solar astronomy experiments are expected not only to increase knowledge about the Sun but also to open new doors to basic knowledge that will eventually contribute to mankind's benefit. Since so much of what happens on Earth depends on the Sun, Skylab's solar astronomy experiments can prove vital to mankind's future. Study of the Sun can contribute to unlocking the secret of controlled atomic fusion, which is the source of the Sun's energy and which could provide great quantities of clean power on Earth.



Astronomical observatories on Earth are hampered by our atmosphere which blocks most X-ray and ultraviolet radiation from our Sun and the stars. Skylab will operate at an altitude of about 375 kilometers (235 miles) where there is no atmospheric interference and solar and stellar radiations can be clearly observed.

There are a number of science experiments that will provide data in the natural science fields of: cosmic radiation; stellar astronomy; micrometeoroid quantities and composition; and in the nature of low light phenomena associated with the interaction between Sun-ejected particles and the Earth's magnetic field and atmosphere.

The life science experiments are aimed at increasing knowledge about how life processes are affected by the space environment. Primarily, scientists are interested in identifying the precise mechanisms that change the chemistry of the human body when Earth's gravity is absent. This knowledge is important not only in determining how to control adverse reactions during long space flights but it also can contribute to an understanding of life processes, which are basic to treating human illness.

Manufacture of products not possible on Earth may be possible in zero gravity (weightless) conditions. Casting of perfect spheres, growth of pure crystal structures, and development of high strength materials are some of the space manufacturing techniques to be tested.

Skylab will also lay a groundwork for future, more permanent space stations and for the years-long manned missions to other planets of our solar system, when they are undertaken. Some of Skylab's experiments are aimed at improving structures and equipment for space operations, designing more habitable spacecraft and learning how to maneuver and work inside a space station.

Unlike previous manned space flight programs, Skylab provides a means for astronaut rescue, should trouble occur. A Command/Service Module (CSM) similar to the one in which astronauts will commute to and from Skylab can be modified into a rescue vehicle accommodating five rather than three crewmen. Two astronauts can pilot the modified CSM to Skylab and bring back Skylab's three crewmen.

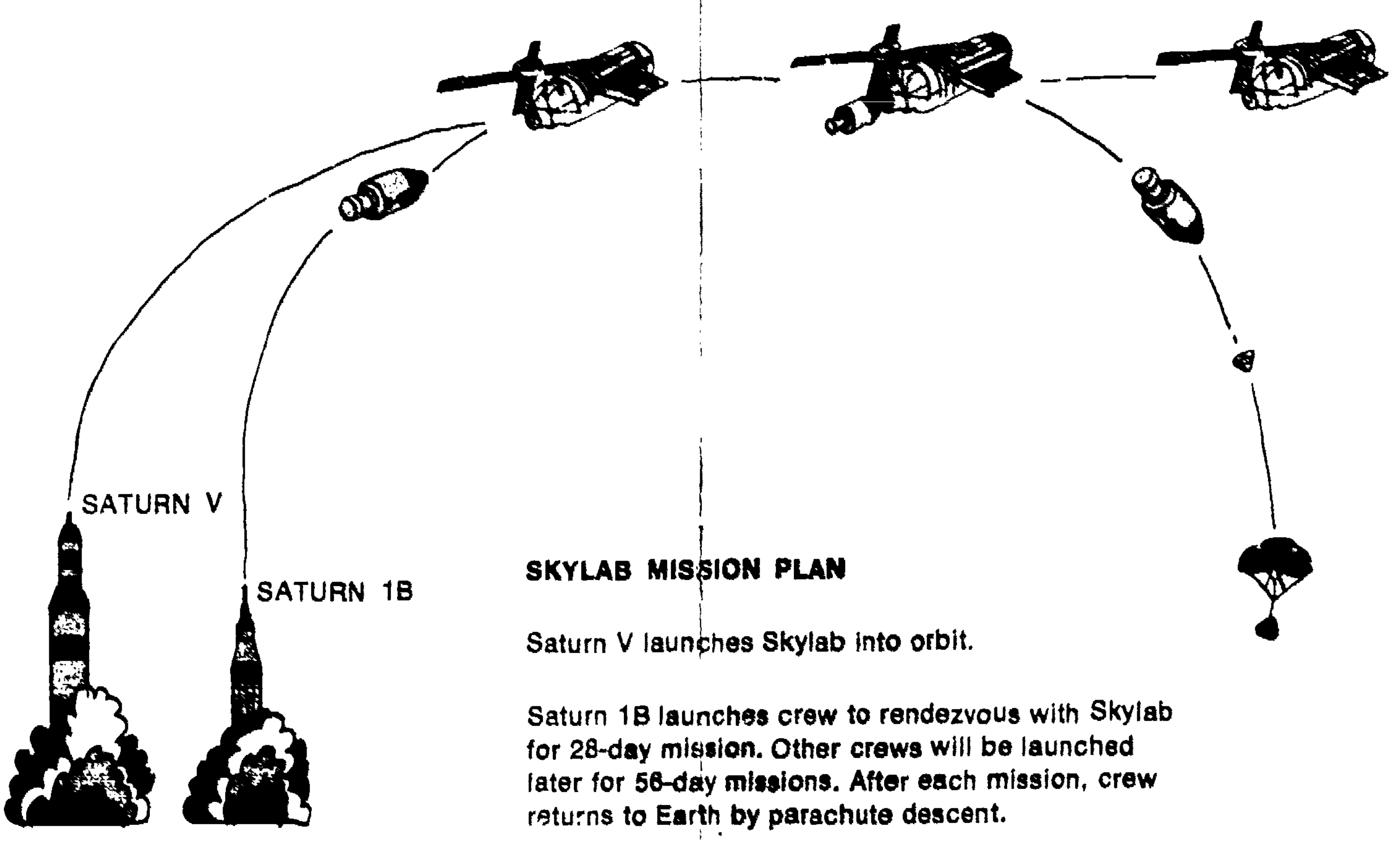
Skylab will operate in space for about eight months during which time there will be three manned missions separated by two periods of unmanned operation. The first mission will begin in the spring of 1973 with two launches from Kennedy Space Center, Florida.

The first launch will be unmanned. The first two stages of a Saturn V launch vehicle will place the Skylab into Earth orbit.

The next day a manned modified Command/Service Module (CSM), much like the one used in the Apollo lunar exploration program, will be sent into Earth orbit by the smaller Saturn 1B launch vehicle. On board the CSM will be Skylab's first three-man crew. The crew will dock the CSM with the Skylab. The crew will then activate Skylab.

In Skylab, the crew will be able to work and relax unencumbered by space suits. Its facilities will enable the astronauts to eat, sleep, wash, exercise, and work for periods of up to 56 days in space. Skylab's living space is about that of a small two-bedroom house.

After four weeks in space, the crew will return to their CSM, pull away from the rest of Skylab, and go through the



SKYLAB MISSION PLAN

Saturn V launches Skylab into orbit.

Saturn 1B launches crew to rendezvous with Skylab for 28-day mission. Other crews will be launched later for 56-day missions. After each mission, crew returns to Earth by parachute descent.

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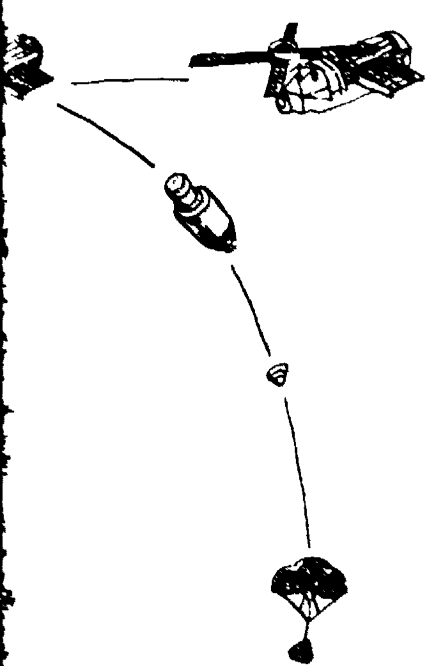

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sequence of atmospheric entry, parachute descent, and splashdown in the West Atlantic Ocean. There, a recovery force will pick up the crew.

About sixty days later, another crew will be launched in a CSM into orbit. This crew will conduct Skylab experiments for eight weeks before returning to Earth.

Some thirty days after the return of the second crew, a third crew will be rocketed up to Skylab. This crew will also conduct experiments for 56 days before returning home.

SKYLAB STUDENT PROJECT

The Skylab Student Project was designed to stimulate interest in science and technology. It resulted in submissions by United States secondary school students of several thousand proposals for space experiments and demonstrations for Skylab. A limited number of the experiments proposed by the students will be conducted on Skylab in the course of Skylab missions.

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WASHINGTON, D.C. 20546

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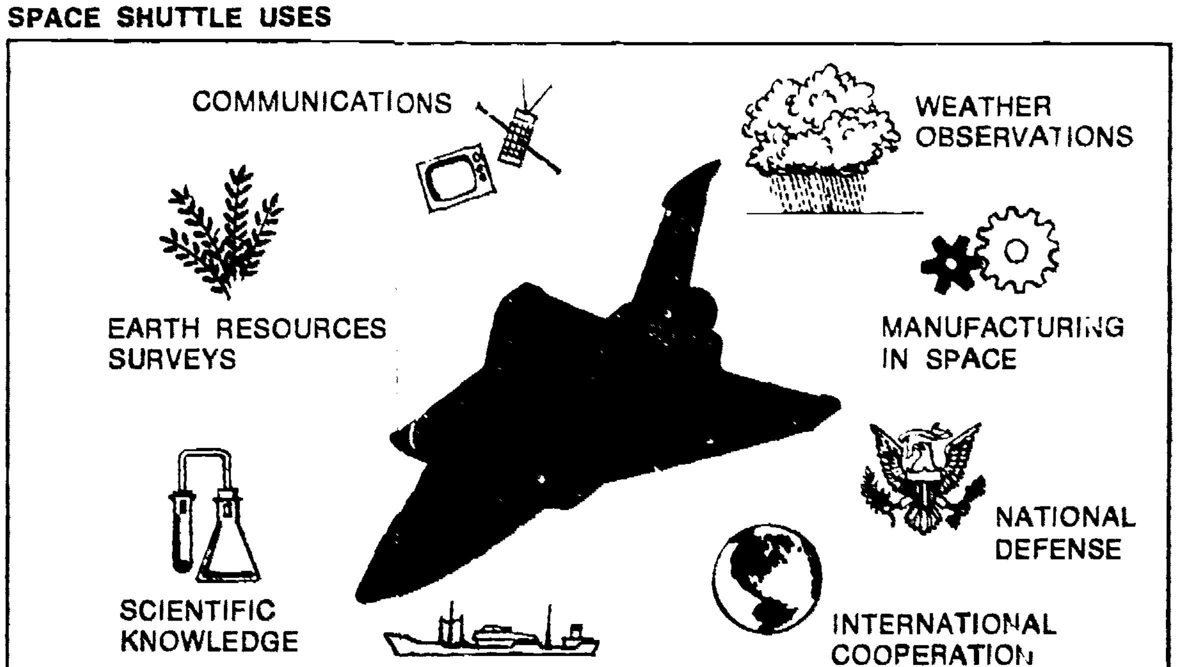
SPACE SHUTTLE

The Space Shuttle will be a space transportation system designed to carry out various missions in Earth orbit at a fraction of the cost of present systems. It will consist of two stages, a booster for launch from Earth, and an airplane-like manned reusable orbiter for flight into orbit where it will conduct space missions. Then, the orbiter will be flown back to land at a conventionally sized airstrip.

Four main reasons why the space shuttle is important have been presented by Dr. James C. Fletcher, NASA Administrator.

First, the space shuttle is needed to do useful things. The shuttle will be able to send most unmanned applications spacecraft into orbit; for example, communications, weather, navigation, Earth resources observation satellites and military spacecraft.

SPACE SHUTTLE USES



The uses of the space shuttle will include launching of unmanned spacecraft into orbit for missions such as those indicated.

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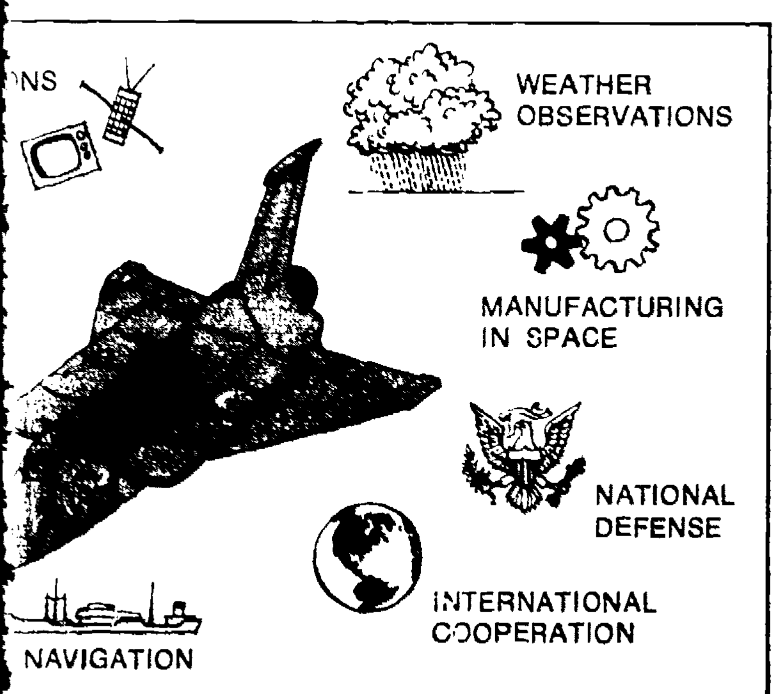

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It will also launch scientific spacecraft for study of space near and far. With the shuttle, men will supervise the launch and placement of the satellites and will be able to service and repair them as needed. Thus, launch vehicle and satellite failures, which require the construction of a whole new satellite, will become things of the past.

"The United States should proceed at once with development of an entirely new transportation system designed to help transform the space frontier of the 1970's into familiar territory, easily accessible for human endeavor in the 1980's and 1990's . . . The continued preeminence of America and American industry in the aerospace field will be an important part of the shuttle's payload."

President Richard M. Nixon, January 5, 1972.

Second, the space shuttle is needed to make space operations less complex and less costly. Today, NASA has to mount an enormous effort for a space mission. And the costly launch vehicle is used but once. The space shuttle will launch payloads into Earth orbit at costs substantially less than the expense of current space operations.

The key to this cost reduction is that major parts of the shuttle system are reused rather than thrown away. Such a next step in space is appropriate and logical. After all, a transcontinental airliner is not discarded after a single trip. The shuttle will greatly reduce the cost and difficulty of preparing payloads because of its easier environment, its volume and weight capacity and its capability for retrieval and repair.

Third, the shuttle is the only meaningful new manned space program which can be accomplished on a modest budget. Man has worked hard to achieve freedom of mobility on land and sea, and in the air. In the past dozen years, he has gained the freedom of space. The Space Shuttle will extend man's ability to do useful work in space while contributing to economy of space operations. The Space Shuttle will make launching of payloads into Earth orbit a virtually routine event.

Fourth, the shuttle will encourage far greater participation in space flight. With the shuttle's easy and routine access to space, scientists, engineers and astronauts will be able to go into orbit to supervise and check on their space experiments. You don't have to be an astronaut to ride the Space Shuttle. Healthy individuals will be able to withstand the mild forces of acceleration and deceleration experienced when the shuttle is launched and reenters the atmosphere. In addition, the shuttle will be built and pressurized so that passengers such as scientists, engineers and others will be able to ride in ordinary clothing, as in an airliner. Also by lowering the cost of space operations, the shuttle will encourage more nations to participate in space activities. Such joint experiments, joint environmental monitoring, and perhaps other joint enterprises will contribute toward making the benefits of space exploration available to all people.

The shuttle will be launched vertically. The orbiter will separate from its booster and go into orbit under its own power. When it accomplishes its mission, its pilots will fire its rockets to slow it down, fly it through the atmosphere, and land it like an airplane on a jet size airstrip.

The delta-winged manned orbiter will be about the size of a DC-9 airplane. The cargo compartment, which can accommodate experiments and passengers, will be about 4½ meters (15 feet) in diameter and up to 18 meters (60 feet) long. The orbiter will be able to carry cargo and/or passengers weighing in total as much as 29,500 kilograms (65,000 pounds).

The shuttle orbiter crew will consist of two pilots and two flight engineers. Maximum G forces on launch

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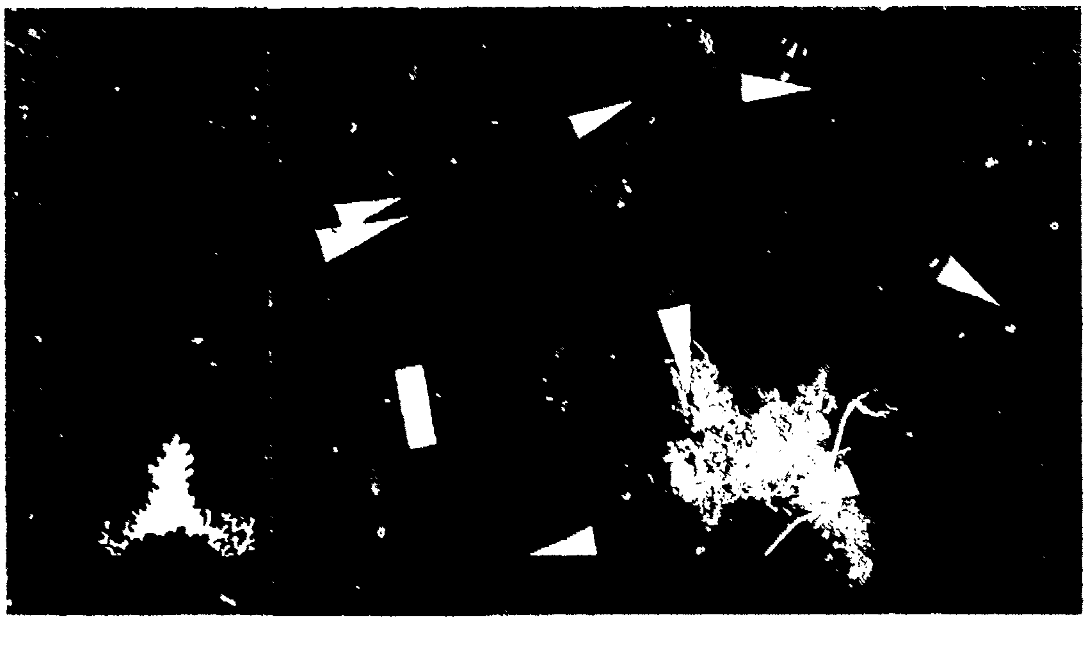
SPACE SHUTTLE MISSION PROFILE



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The shuttle orbiter crew will consist of two pilots and two flight engineers. Maximum G forces on launch and reentry will be no more than a mild 3G.

The shuttle after entry will not have to follow a ballistic trajectory to the ground. It will be able to maneuver right or left some 1760 kilometers (1100 nautical miles). Each orbiter will be designed for reuse up to a hundred times.

The Space Shuttle is expected to be ready to play its major role in space by the end of this decade. It will then be used to launch all but the very smallest and very largest payloads. It will send some spacecraft into orbit from which the spacecraft's own rockets would send them into higher orbits or toward the Moon and other planets.

The shuttle represents an investment in mankind's future. It can provide dividends that will continue for decades to come.

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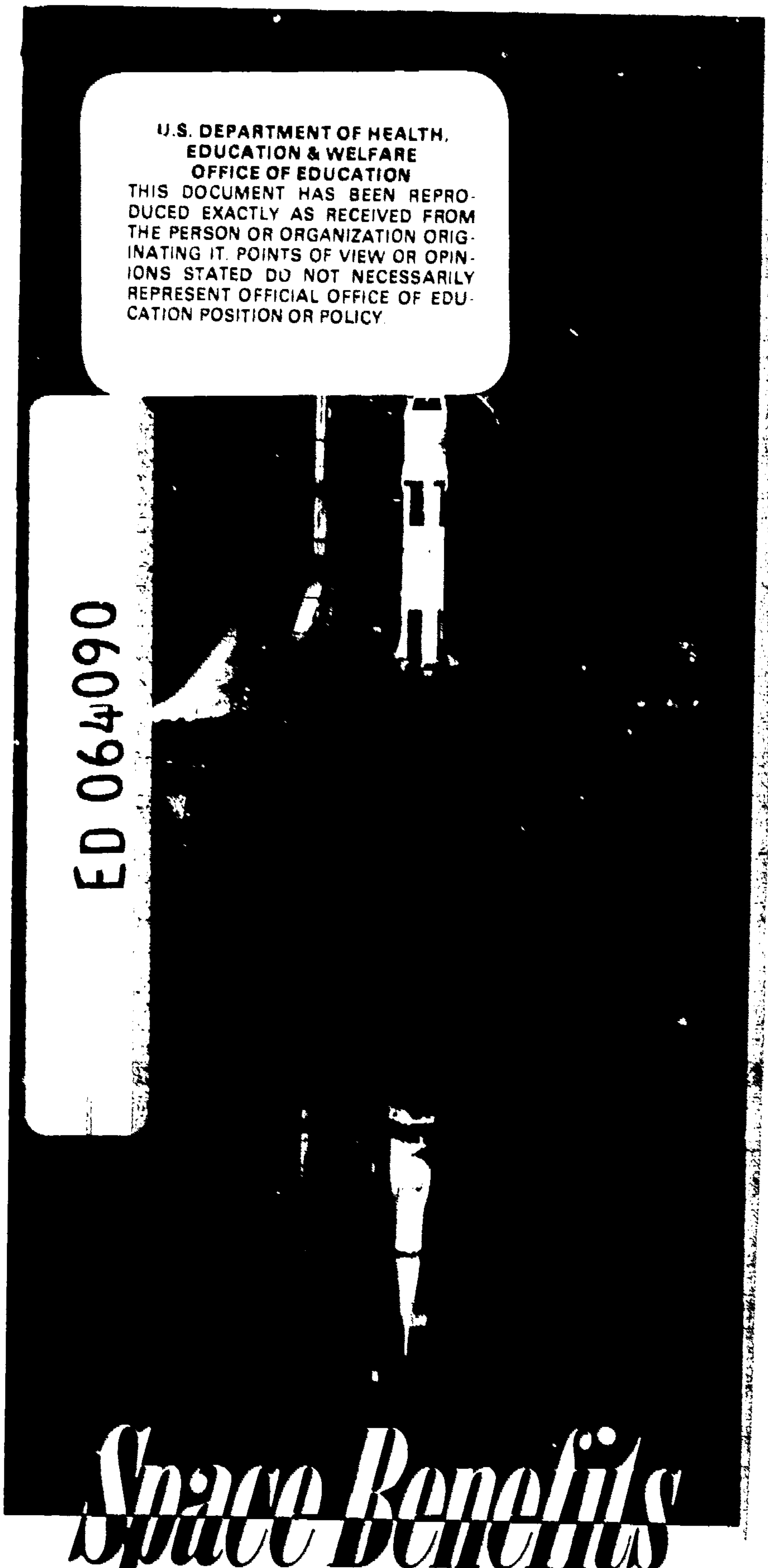


Space Benefits today and tomorrow

"The Congress hereby declares that it is the policy of the United States that activities in space should be devoted to peaceful purposes for the benefit of all mankind."

Section 102 (a)
National Aeronautics and Space Act of 1958

Why is the United States Exploring Space?

The Space Act of 1958 adopted by the Congress and signed by President Dwight D. Eisenhower determined that the nation would develop and utilize space transportation systems for the acquisition of knowledge, for national defense, and in the interest of peace.

The law established the foundation for a two-fold program. One is conducted by the Department of Defense and is related to protecting the nation from attack through space. The other is conducted by the National Aeronautics and Space Administration in the pursuit of knowledge and the application of that knowledge to benefit mankind.

Our progress today, as in the past, depends upon exploration of unknowns.

What Has the United States Accomplished?

The charge placed upon Defense and NASA by the Congress in 1958, and supported by succeeding Administrations and Congress since then, required the development of rockets, engines, launch facilities, guidance systems, data acquisition systems, tracking and communications systems, and spacecraft which could perform effectively in a largely unknown environment over vast distances, and some of which in combination could transport men and their Earth environment to and from the Moon.

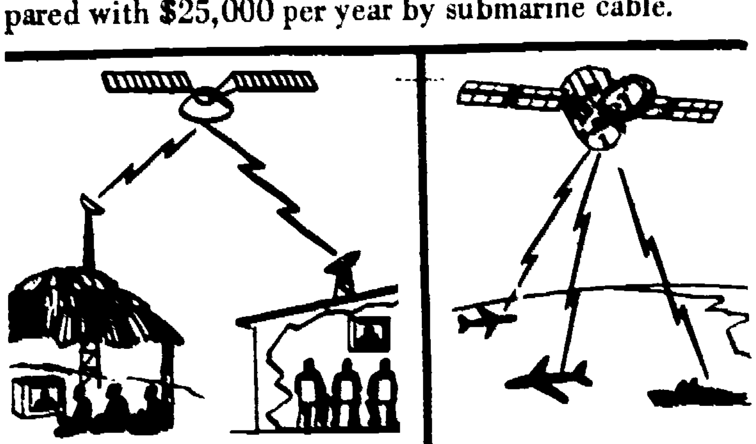
All of these things have been accomplished by the integrated efforts of Government, science, and U. S. industry.

New Tools for Mankind

The prodigious research, development and manufacturing effort harnessed by Government under the terms of the Space Act has spawned many tools useful to mankind and placed at man's disposal new technology which will be applied here and abroad to produce novel and better products for society. Advances in computers, miniaturization, electronics, exotic materials, and many other by-products have become part of our way of life almost without recognition.

Communications

The Earth-revolving communications satellite has within a decade progressed from novelty to an operational tool. Every television viewer knows that he sees and hears events occurring across continents and oceans because of satellite relay. One communications satellite transfers 9,000 phone calls, 12 color television programs, or any combination, between North and South America, Europe and Africa. Relay costs approximate $4,000 per channel per year compared with $25,000 per year by submarine cable.



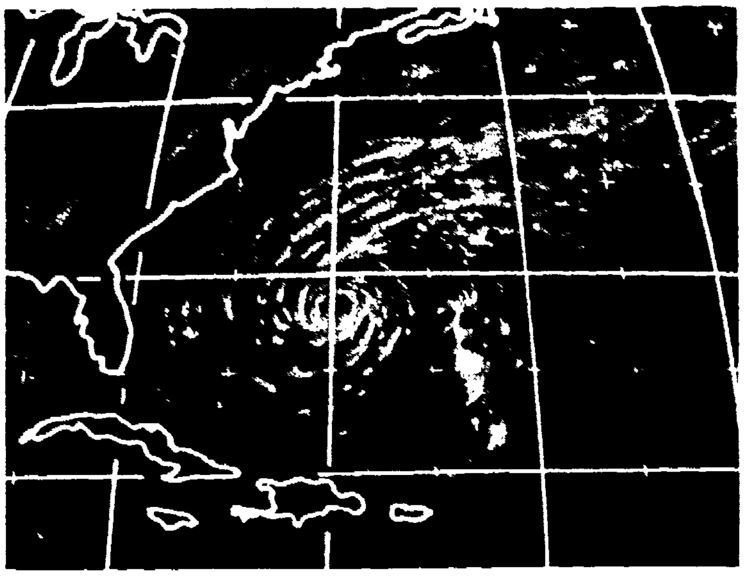
Seventy-six nations own the International Telecommunications Satellite Consortium, for which NASA places satellites in orbit. The network has 42 ground stations in 29 countries, leases 2,000 circuits full time and relays 1,000 hours of television around the world every year. Its financial success alone demonstrates the commercial potential of space.

Weather

The most significant advances in weather reporting of this century, perhaps even since the invention of the barometer, were achieved through progressive development of meteorological satellites to a fully operational system which supplies data to the National Weather Service.

Global weather reporting through international participation has been expanding for 75 years, but, until the advent of weather satellites, the weather information came from less than 20 percent of Earth. The other 80 percent, primarily the oceans, was covered only by scattered observations.

In the early 1960s, the weather satellite made possible observation of the entire surface of Earth on an all-encompassing basis. What the satellite saw and measured was immediately transmitted to ground stations, permitting the expert interpretation of data on a timely basis. Today's orbiting spacecraft, equipped with cloud cover cameras, enable man to observe the atmosphere continuously and to track severe storms. Four satellites, properly spaced above and around Earth, would monitor nearly all of Earth's cloud cover all the time.



Fifty nations use the information provided by the network of U. S. satellites, launched by NASA for the National Oceanographic and Atmospheric Administration. During the next decade, advanced satellites and computer networks will provide reliable long range weather predictions of two weeks or longer. Eventually the weather satellite could be one of several devices which will make possible weather control and modification. The satellites observe air pollution as well and can become an invaluable tool in reporting the transport and diffusion of pollutants and the effects of weather and climate in its creation and dissipation. Land, sea, air and space transportation operations will proceed with enhanced safety and efficiency because of timely and reliable weather data.

Navigation

Navigation of ships and aircraft requires the determination of exact position, the direction and rate of movement from one point to another, and the ability to communicate that information. Navigation via satellite fills this need admirably.

Satellite navigation systems can provide global coverage and are practically invulnerable to weather, available day or night, and provide instantaneous response.

Earth orbiting satellites discern ship and aircraft positions much more accurately than earlier systems. Such a capability is vital for traffic control in today's fast-moving environment of air traffic. With satellite assist, ground controllers can pinpoint a jet liner's position within approximately one mile.

Agriculture

Aerial photography ushered in a new era of crop and forest observation, but its capabilities were limited when compared to those of the satellite. The orbiting device permits regular, periodic observation in routine operation from distant, all-inclusive views which can make use of multi spectral scanners, infrared sensitive film, television and conventional photographic techniques.

With the aid of satellites and their remote sensors, man can better manage crop and timber resources. He can monitor the state of their health, determine the best time to plant and harvest for maximum yields, detect potential damage to crops from blight or infestation, help improve land use, inventory crops during growth, and have advance warning of drought, erosion and floods.

NASA is forging ahead in developing Earth resources sensing systems in cooperation with the U.S. Department of Agriculture, the U. S. Geological Survey, and many State Governments. The possible applications of satellite observation cover a wide field:

Range surveys	Crop disease and insect detection
Forest fire detection	Agricultural development projects
Land use changes	Watershed and hydrologic studies
Crop identification	Forest disease and insect invasion
Soil classification	Crop acreage control programs
Natural vegetation	Forest species identification
Flood control survey	Recreation site evaluation
Wildlife habitat	Irrigation development

Astronomy

The Earth's obscuring atmosphere has limited the effectiveness of astronomical observations since Galileo's time. By transferring observation equipment to space, outside Earth's envelope, man has acquired the capability to investigate celestial mechanisms which affect life on this planet.

Astronomers have discovered additional X-ray emissions from various regions of space, detected ultraviolet and soft X-ray energies coming from the Sun, and discerned radio waves emanating from Earth that resemble waves which appear to be coming from Jupiter.

Subsequent space projects will further assist astronomy by carrying instruments of larger size and enhanced capabilities. From this research and investigation will come a better understanding of the Universe, and the Earth-Sun-Moon relationships which affect our lives.

Earth Resources

A new and comprehensive view of Earth's resources is offered man for the first time from space.

Every chemical element reflects or radiates a distinctive signature across a spectrum of wave lengths, not unlike the fingerprints of man. Photography by film sensitive to these radiations provides hitherto unavailable information concerning natural resources. Thus with the proper use of this information, a pattern of resource supply can be matched with resource demands.

Through space-borne observation, our geologic knowledge investigates Earth's composition, structure, stratigraphy and history. Geologic features can be mapped regionally. Eventually, with the help of laser reflectometers carried to the Moon by Apollo, we can develop methods for monitoring and predicting natural disturbances such as earthquakes and volcanic upheavals.

Mineral resources – iron, copper, gold – and non-metallic deposits – sand, gravel, limestone, oil and gas – can be detected and measured from space.

Electromagnetic energy and the electrical properties of rocks and terrain are even more effectively observed from space than from the limited height of aircraft observation. Gemini and Apollo photographic observations provided the first, all-inclusive views of the Himalayas and the Andes, the practical applications of locating new oil deposits in Australia, and a photo mosaic of Peru more accurate than any map.

Oceanography

Two-thirds of Earth is covered by oceans. They can be seen in their vastness only from a distant point in space. Just such a view can be utilized to increase our understanding of the oceans, to utilize them as a medium of transport, to detect their influence on weather and climate, and to evaluate them as food sources.

Several techniques of collecting oceanic data by satellite are in use or development:

State of the sea – relationship between wave height and wind force

Thermal conditions and temperature of the sea surface

Sea ice – one of the first oceanographic features pictured by the first U. S. meteorological satellite, TIROS, in 1960

Location of currents and water masses by thermal characteristics and coloration

Mapping coastal areas – an aid in detection of shifts in shoreline resulting from flood and storm

Movement of biological phenomena in the oceans, discernible by heat or color, implies a possible relationship between concentrations of fish and marine organisms – of great value to commercial fishing and the wise use of resources.

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Bonuses

The spinoff of space technology runs the gamut from new industries to better smoking pipes.

Medicine has been one of the biggest beneficiaries of space research. The merging of bioscience and engineering forced by the demands of adapting man to space created many new medical devices and techniques.

Dry, spray-on electrode techniques permit taking an electrocardiogram in the ambulance enroute to a hospital. Sensors smaller than the head of a pin can be inserted into a vein to measure blood pressure without interfering with circulation. An automatic living cell analyzer can produce almost instantaneous blood counts. A switch can be operated by the eye movement of a paralyzed patient. A telemetry unit monitors cardiac patients in intensive care.

A new type of pipe, built of plastic mortar, reinforced with fiberglass, is light, thin-walled, non corrosive and virtually indestructible. A polyurethane spray foam is used to insulate the hull of a tuna ship. An aluminized plastic half a thousandth of an inch thick becomes an emergency blanket.

An electromagnetic hammer is used to build ships and autos. There is a new plastic material for packaging meat. Foamed resins have been used to refloat sunken ships. Better adhesives bond auto trim. A fire resistant material transforms into soft and resilient garments. Semi-conductors three-sixteenths of an inch thick contain more than 1,000 circuits. An anti-skidding device has been applied to trucks. Computer programming has been adapted to such diverse uses as an instant flight and reservations system for airlines and the rapid handling of stock market transactions.

Other and less tangible spinoffs from space have been catalogued. Basic knowledge has been enriched in many fields – in biosciences, physics, geology, astronomy, and engineering. Space has been our best salesman abroad. It has demonstrated our capabilities, our good will, and enhanced U. S. prestige throughout the world.

The transfer of new knowledge derived from space exploration continues both by intent and coincidence. The possibilities exceed our ability to predict them.

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